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COST-BENEFIT ANALYSIS OF SINGLE SITING DEPOT LEVEL MAINTENANCE FOR THE LIGHT ARMORED VEHILCE

by

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December 2000

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ABSTRACT

In 1998, Commander, Marine Corps Logistics Bases established the Executive Planning Group (EPG) to develop and coordinate strategy to enhance the depots' maintenance and supply capabilities in order to increase the competitiveness of their services and provide a direction for future depot operations. One of the intiatives introduced by the EPG was to conduct an analysis to determine if consolidating depot maintenance for the LAV from the current workload scenario at two depots, to a single site, results in the most efficient allocation of resources. We use spreadsheet models to conduct a comparative cost and savings analysis between the current split workload scenario and a single site scenario at each depot. We address costs and savings resulting from data such as infrastructure requirements, transportation, inventory reductions, and reduction in personnel structure requirements. We also address additional issues such as the impact on readiness and surge capacity. Our results vary significantly depending on the selection of depot for single siting. We show that single siting at one depot results in annual savings from the current workload scenario, while single siting at the other depot increases annual costs from the current workload scenario.

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I. INTRODUCTION

A. BACKGROUND

Over the past decade, The Department of Defense (DoD) has realized a reduction in defense spending resulting from the end of the cold war. Reduced budgets have placed constraints on the maintenance and supportability of weapon systems among services, which have challenged logisticians in all communities. As a result, there have been many DoD reform initiatives directing services to transform logistics processes to improve efficiency and reduce costs, while simultaneously maintaining readiness levels required to support our 21st century forces.

Marine Corps Logistics Bases (MCLB) responded by initiating reforms aimed at reengineering business processes to reduce inventories, decrease depot maintenance cycle times, and improve the allocation of resources. In 1998, Commander, MCLB established the Executive Planning Group (EPG) to develop and coordinate strategy to enhance the depots' maintenance and supply capabilities in order to increase the competitiveness of the depots' services and provide a direction for future depot operations. One of the initiatives introduced by the EPG was to conduct an analysis to determine potential benefits realized by consolidation of depot maintenance of the Light Armored Vehicle (LAV) [Ref. 1].

Currently, depot maintenance for the LAV is performed at both MCLB's located in Albany, Georgia and Barstow, California. Each base provides multi-commodity depot

maintenance capabilities for similar ground combat and ground combat support equipment for units within their geographical regions. This capability provides each depot the ability to shift maintenance capacity from one production line to another as organic workload fluctuates. While this policy enables increased flexibility and surge capacity, similar maintenance capabilities at both maintenance centers results in duplication of inventories, increased direct and indirect labor requirements, increased scheduling requirements, and differences in production processes.

The issue of consolidating maintenance and reduction of depot infrastructure is not new. Numerous studies have been conducted to analyze the potential costs and benefits from maintenance consolidation. Cook (1996), concluded that consolidating specific hydraulic maintenance capabilities for the F/A-18 within geographical regions reduces RCT, personnel requirements, and spares inventories, which results in net annual savings.

Paige (2000) modeled the potential savings and costs realized from a virtual consolidation of the management of Marine Corps Secondary Repairables (SecReps). His model did not show significant savings when considering the transportation costs of shipping components to geographically dispersed units throughout the United States and Japan.

General Went, USMC (Ret) (1993) conducted a study for the Office of the Joint Chiefs of Staff that addressed the various services' depot maintenance capacity and utilization. He suggested that excess capacity did exist within the service depots and that

savings could be realized by consolidating similar service depot maintenance capabilities to consolidated joint depots. His study focused on the potential closing of service depots where duplicate maintenance capabilities existed and could be efficiently transferred to joint depots.

While each of these studies are unique in scope, they all focus on one theme: to determine if consolidation of maintenance efforts will result in improved resource allocation, while considering the trade-offs involved with each concept.

B. PURPOSE

The purpose of our research is to determine if consolidating depot maintenance for the LAV to a single site results in the most efficient allocation of resources, while addressing the tradeoffs involved with this initiative. Specifically, we address costs and savings resulting from data such as infrastructure requirements, transportation, inventory reductions, reductions in personnel structure requirements, and reductions in total unit Direct Labor Hour (DLH) costs. Additionally, we address factors that are harder to quantify, such as impact on surge capacity, potential risk of single siting maintenance of a major weapon system, and the potential impact on maintenance scheduling. Finally, we estimate the impact on readiness resulting from single siting while considering increased transportation lead times and potential change in Repair Cycle Times (RCT).

C. METHODOLOGY

We use the Inspect and Repair Only as Necessary (IROAN) Program for the LAV as the basis for our research. During Fiscal Years (FY's) 1998-2000, the IROAN

Program accounted for over 92% of the depot maintenance requirements for the LAV [Ref. 2].

We present five spreadsheet models that identify estimated costs and savings associated with consolidating LAV depot maintenance to a single site. We present the spreadsheets considering the current workload scenario at both depots, then we show the savings (costs) associated with single siting at either Albany or Barstow. Consideration for location of a single site is a strategic decision based on several political, financial, logistical, and operational factors beyond the scope of our research. Therefore, we do not make a specific recommendation as to which depot might be the best for single siting.

First, we develop an average annual demand for depot maintenance of the LAV generated from actual throughput data for FY's 1998 and 1999, as well as estimated annual demand for FY's 2000-2003. We present a total average annual demand that is used to generate transportation cost data for the LAV as a Principle End Item (PEI) and an average annual demand, by variant, that is used to develop our readiness model.

Our second spreadsheet model develops transportation costs using the total annual demand from our Annual Demand model and cost estimates provided by the Logistics Support Section, Life Cycle Management Center (LCMC), MCLB.

Our third spreadsheet model presents transportation costs associated with single siting the Depot Level Repairable (DLR) inventory and repair capability for the LAV. Our model describes the demand placed on the DLR repair facility from supported

Marine Expeditionary Force (MEF) units. We then develop transportation costs from the current workload and single site scenarios at both depots.

In our fourth spreadsheet model, we estimate the impact on readiness of each of the seven LAV variants that currently participate in the IROAN Program, based on the current workload and single siting scenarios. Additionally, we provide DLH costs using data from our Annual Demand model and DLH cost estimates provided by the LAV Project Officer, Maintenance Directorate, MCLB [Ref. 3].

Our fifth spreadsheet model totals the costs and savings associated with each model to arrive at a net savings (cost) per year.

We also address potential savings from consolidated Class IX repair part inventories. Due to data collection difficulties for LAV specific repair parts, we discuss theoretical opportunities that lead to holding cost savings from consolidating inventories.

Lastly, we provide an example of potential savings from personnel reductions resulting from single siting. Conversation with key personnel at both maintenance centers, and the Deputy Director, Maintenance Directorate, MCLB, indicate the difficulty of estimating the impact on personnel requirements from single siting the LAV. Therefore, we use an estimated percentage decrease in the amount of labor required of a single site concept to give a conservative example of potential savings. A more detailed analysis of the production line design and total management (indirect) labor requirements for a consolidated site is needed to arrive at a more accurate estimate [Ref. 4, 5, 6].

D. THESIS ORGANIZATION

The rest of the thesis is organized as follows: Chapter II describes the current LAV IROAN process. Chapter III develops the five spreadsheet models and presents additional issues concerning consolidation to a single site. Chapter IV presents conclusions and recommendations.

II. THE CURRENT DEPOT MAINTENANCE PROCESS

A. BACKGROUND

The Maintenance Centers at Albany and Barstow provide up to fifth echelon (depot-level) maintenance support for Fleet Marine Force (FMF), non-FMF, and reserve units, as well as other services and agencies. Each maintenance center is located to support units within its geographical region. Generally speaking, MCLB Albany supports units on the eastern half of the United States, while MCLB Barstow supports units on the western half of the country, including units in Hawaii and Okinawa, Japan. Table 2.1 provides a list of units possessing LAV assets supported by each depot.

Unit	Depot
2d LAR Bn, Camp Lejeune, NC	Albany
2d Radio Bn, Camp Lejeune, NC	Albany
Blount Island Command, Jacksonville, FL	Albany
Aberdeen Proving Ground, MD	Albany
Co. B, 4th LAR Bn, Ft Detrick, MD	Albany
Co. D, 4th LAR Bn, Quantico, VA	Barstow
1st LAR Bn, Camp Pendleton, CA	Barstow
3d LAR Bn, 29 Palms, CA	Barstow
Enhanced Equipment Allowance Pool (EEAP), 29 Palms, CA	Barstow
Co. A, 4th LAR Bn, Camp Pendleton, CA	Barstow
Co. C, 4th LAR Bn, Ft Tooele, UT	Barstow
School Of Infantry (SOI), Camp Pendleton, CA	Barstow
1st Radio Bn, Hawaii	Barstow
Combat Assault Battalion (CAB), 3d Marine Division, Okinawa,	Barstow

Table 2.1. Depot Support For Units Possessing LAV Assets

The maintenance centers do not specialize in support of specific commodities, rather they possess a multi-commodity capability that enables them to support ground

combat equipment and ground combat service support equipment for units within their regions of responsibility, as well as overflow maintenance requirements from the other depot.

The multi-commodity capability provides an infrastructure and workforce capable of supporting a variety of weapon systems and components. This enables each maintenance center to quickly shift work from one line to another to meet changing requirements of supported units. Because the organization of forces and equipment are basically the same for the units supported by each depot, duplicate maintenance capabilities are required at each location.

Exceptions to this policy do exist, however. Depot maintenance for specific weapon systems and components are currently single sited. For example, the M198 Howitzer, five-ton truck, and thermal sites for various weapon systems are supported by MCLB Barstow exclusively, while the Logistics Vehicle System (LVS) is supported by MCLB Albany.

B. DEPOT CAPACITY

Department of Defense (DoD) Directive 4151.18_ defines required depot maintenance capacity as: "an indicator, expressed in Direct Labor Hours (DLH), required by a shop or depot to support funded workload requirements and provide essential core capabilities." Depots calculate DLH by production shop categories that include similar weapon systems. For example, the LAV falls under the production shop category Ground Combat Vehicles, which includes self-propelled artillery vehicles, tanks, and towed

combat vehicles. The production shop categories are then aggregated to report the total required depot maintenance capacity [Ref. 7]. Due to the multi-commodity capability of MCLBs, capacity can be shifted from one production line to another as depot maintenance requirements change for the various weapon systems. Both the Director, Maintenance Center, Albany, and the Deputy Commander, Maintenance Center, Barstow, estimate that because of the current multi-commodity capability of both depots, no additional capacity is required to support single siting LAV depot maintenance. However, consolidation of depot maintenance for the LAV may lead to a trade-off in that the depot gaining the LAV workload transfer equivalent depot maintenance workload for other weapon system(s) or components to the other depot [Ref. 4, 5].

C. DEPOT INFRASTRUCTURE

MCLBs infrastructure can be viewed as the facilities, technology, and equipment needed to accomplish the required maintenance and supply support of Marine Corps weapon systems and their components. Despite the two maintenance centers having similar depot maintenance capability to support the LAV, some of their processes differ. For example, Albany uses a live-fire facility to test the 25-millimeter chain gun on the LAV-25, while Barstow uses a dry-cycle fire test that cycles inert ammo through the gun to test for specific load capacity and cycling rates. Additionally, Albany uses a static four-axle chassis dynamometer that tests the components of the drive train, while Barstow uses a mobile, towed chassis dynamometer.

One exception exists with regard to similar LAV maintenance capabilities for the two maintenance centers. Barstow possesses exclusive maintenance capabilities for LAV thermal sites within the Marine Corps inventory. The Director, Maintenance Center, Albany, and the Deputy Commander, Maintenance Center, Barstow, recommend leaving the thermal site maintenance capability in place at Barstow, and believe that no additional facility upgrade is required to support the single siting of the LAV. Therefore, we do not consider infrastructure changes. [Ref. 4, 5].

D. THE LAV IROAN PROCESS

The IROAN Program is a life cycle management program that provides depot maintenance for a weapon system at scheduled intervals throughout its life cycle. The purpose of the IROAN Program is to conduct a complete inspection and testing of a weapon system within guidelines established in a Statement Of Work (SOW) and to make repairs as necessary. The SOW specifies the extent of the work required and identifies what components are to be rebuilt, repaired, replaced, or inspected and repaired only as necessary (IROAN). LAV IROAN repairs range from 100% replacement of specific repair parts to the repair of the vehicle hull to the repair or rebuild of Secondary Repairables (SecReps).

There are seven different variants of LAV that are scheduled annually for the IROAN Program. The hull of each variant is basically the same, but each variant has specific weapon systems, components, and capabilities. The seven variants include the

Anti-Tank, Command and Control (C2), 25 millimeter chain gun (25), Logistics (Log), Mortar, Recovery, and Mobile Electronic Warfare Support System (MEWSS).

Scheduling for the LAV IROAN is based on a Mean Time Between Overhaul Maintenance ($MTBM_{overhaul}$) of 1826 days. Additional factors that effect the annual requirements and scheduling are: funding constraints, operational commitments of supported units, and depot maintenance capacity and utilization considerations. Once the final number of LAV's is determined, the annual workload is reflected on the Master Work Schedule (MWS) for each depot, reflecting Required Delivery Dates (RDD) for the arrival of each vehicle. The RDD serves as a tool to regulate the flow of work into the maintenance center to prevent queues or gaps from developing in the production line. The MWS is the production schedule for each depot that specifies which Principal End Items (PEIs) and SecReps are scheduled for repair every year [Ref. 8].

LAV's arrive at the depot and are sent to the Fleet Support Center (FSC) where they are prepared for induction into the maintenance cycle. If the maintenance center is not ready to accept the LAV, it sits in a queue at the FSC.

Once the LAV enters the production line, SecReps requiring testing or repair are removed and inducted into a "backshop" while the vehicle proceeds through the repair line. A backshop is a repair facility that inspects, tests, repairs or rebuilds specific components for the weapon system. Upon completion of the repair cycle, the LAV is reassembled with its components, a final quality assurance inspection is conducted, and

the vehicle is returned to the FSC for preparation for shipment to the next using unit as a replacement vehicle, or put back into Depot Maintenance Float Allowance (DMFA) pool.

Marine Corps policy is to ensure unit readiness is maintained at acceptable levels while unit equipment is undergoing depot maintenance. To support this policy, the DMFA was established to provide a quantity of Ready For Issue (RFI) equipment available to units that induct items into the depot maintenance repair cycle. The DMFA assets are maintained and managed by both depots and are used to provide units with replacement vehicles prior to shipment of an LAV for IROAN. If DMFA assets are not available for issue to units prior to the scheduled RDD, the unit may be required to go Table of Equipment (T/E) deficient until a replacement item is received from the depot. Table 2.2 provides a list of LAV DMFA assets, by variant [Ref. 9, 10].

Depot	Anti-Tank	C2	25	Log	Mortar	Recovery	MEWSS
Albany	5	3	20	5	2	2	0
Barstow	5	2	20	4	2	2	0
Total	**10**	**5**	**40**	**9**	**4**	**4**	**0**

Table 2.2. Marine Corps LAV DMFA Assets.

E. THE CURRENT DEPOT INVENTORY POLICY

1. Class IX Repair Parts

The Material Control Center Corporate Operating Procedures (MCC COP) establishes policy for both depots' Material Control Centers (MCC) in the performance of material, inventory, and distribution management. The MCC COP states that the MCC is responsible for overall centralized planning and management of all materials necessary to affect successful production within each maintenance center. This includes, but is not

limited to, material requirements determination, procurement, requisitioning, receipt, and physical inventory of Class IX consumable repair parts.

Current repair part requirements determination begins with the Master Work Schedule (MWS). Each PEI and SecRep scheduled for repair or rebuild will have a detailed requirement of work to be performed stated in the SOW. Production and material planners then compare the SOW to an Engineering Bill of Material (EBOM) to determine applicable washout or replacement factor rates for each component. The EBOM provides a complete listing of components, with applicable washout rates, for each PEI or SecRep. The final product of the material requirements determination process is a tailored Manufacturing Bill of Material (MBOM). The MBOM describes only those parts and quantities needed to accomplish the rebuild requirements identified in the SOW. The MBOM is used to forecast material requirements taking into consideration the scheduled flow of PEI's or SecReps identified in the MWS.

Current depot inventory policy establishes the Requisitioning Objective (RO) as the maximum quantity per component to be maintained. The RO consists of the sum of the required Operating Level (OL) and the Reorder Point (ROP), multiplied by the Daily Usage Rate (DUR). The RO for each component is calculated as follows:

$$RO = (OL + ROP) * DUR$$

$$ROP = (OST + SL) * DUR$$

where,

OST = Order Ship Time

SL = Safety Level

The *OL* is identified as the quantity of material required to sustain production during the interval between initiation of stock replenishment and the arrival of replenishment shipments. *ROP* is the inventory level at which stock replenishment is initiated. *OST* is the time elapsed between the initiation of stock replenishment and the receipt of materials. *SL* is the quantity of material required to ensure uninterrupted production that may occur from fluctuations in demand. *DUR* is defined as the components' estimated daily usage rate, expressed as quantity per day. *DUR* is based on historical demand as recorded in the Navy Industrial Material Management System (NIMMS). *NIMMS* is an automated system used by each depot to account for inventories and usage of purchased material. *DURs* for components that do not have historical data recorded will reflect engineering estimates until sufficient actual demand can be determined [Ref. 11].

2. Secondary Repairables (SECREPS)

SecReps are components designated as repairable, when it is determined that it is more economical and timely to repair than purchase. SecReps provide MEF commanders with a pool of critical, repairable assets needed to maintain satisfactoy levels of material readiness. SecReps are further broken down into two separate categories: Field Level Repairables (FLRs) and Depot Level Repairables (DLRs). FLRs are repairables that can be repaired at supporting Combat Service Support (CSS) organizations that possess third

and fourth echelon maintenance capability. DLRs are designated as SecReps requiring depot level repair, beyond the maintenance capability of the MEF CSS organizations.

Each MEF has a CSS organization, called Force Service Support Groups (FSSGs) that own and manage inventories of SecReps needed to support operations. The FSSGs also provide field level (third and fourth echelon) maintenance and retail supply support to MEF units. The Marine Corps has three FMF FSSGs located at Camp Pendleton, California; Camp Lejeune, North Carolina; and Okinawa, Japan. FSSGs also have smaller, subordinate units called Combat Service Support Detachments (CSSDs) that support FMF units geographically dislocated from the MEF headquarters. Each FSSG organization receives additional SecRep support from the Depot SecRep Program for those components that are either beyond their repair capability or are designated as unserviceable [Ref. 12].

The Depot SecRep Program exists to provide a source of serviceable repairables to supported FMF and non-FMF organizations. Each depot possesses maintenance capability for LAV SecReps, as well as an inventory of LAV DLR assets, to support units within their geographical region. The LAV DLRs are centrally-managed by the LAV Inventory Manager, LCMC, MCLB, therefore, required inventory levels are determined as a single, consolidated inventory instead of two decentralized inventories to support each depot.

Initial inventory levels of SecReps are determined by CG, MCLB, Albany, during the provisioning process. No changes will be made to the original allowances until a

two-year initial usage period has expired and actual usage data can be determined. After expiration of the two-year initial usage period, allowances for DLRs are computed semi-annually during a SecRep stratification process, during which determination for allowances and allocation of DLRs are made based on monthly forecasted demand, repair rates, washout rates, and administrative and production lead times [Ref. 13].

III. MODELS

A. ANNUAL DEMAND

We develop a total annual LAV IROAN demand for each depot by taking the average of actual throughput for FY's 1998 and 1999, and estimated annual demand for FY's 2000-2003. We total the number of vehicles, by owning unit, for all six years and divide by the total number of years (six) to arrive at an average total annual demand. The results, listed in Table 3.1, describes what units and locations the LAV's will be originating from and the depot that supports those units. The total number of LAV's for both depots serves as the aggregate demand for the single site concept. This data is used to develop transportation costs in our Transportation Cost model.

We obtained the input data used to develop these estimates from the LAV Inventory Manager, MCLB (see Appendices A and B). The input data for FY's 2001-2002 reflect a decreased number of LAV's scheduled for the IROAN Program due to funding constraints for these three years.

FROM	TO	Qty
2d LAR Bn, Camp Lejeune, NC	Albany	15
2d RAD Bn, Camp Lejeune, NC	Albany	1
Aberdeen Prov Grounds, MD	Albany	1
Co B, 4th LAR Bn, FT Detrick, MD	Albany	5
Co D, 4th LAR Bn, Quantico, VA	Albany	4
1st LAR Bn, Camp Pendleton, CA	Barstow	16
EEAP, 29 Palms, CA	Barstow	3
3d LAR Bn, 29 Palms, CA	Barstow	14
1st RAD Bn, Hawaii	Barstow	1
School Of Infantry, Camp Pendleton, CA	Barstow	3
Co A, 4th LAR Bn, Camp Pendleton, CA	Barstow	5
Co C, 4th LAR Bn, TOOELE, UT	Barstow	3
CAB, 3d Marine Division, Okinawa	Barstow	5
Total		**76**

Table 3.1. Estimated Total Annual LAV IROAN Demand.

Our data shows that Barstow has a significantly larger annual IROAN demand than Albany, with Barstow accounting for approximately 66% (50 of 76) of the total annual demand. This is due to the greater density of LAV owning units in the geographical region supported by Barstow.

Next, we breakdown the total annual demand to show annual demand by variant for each depot. We use this data to develop our Readiness and DLH Cost model.

Depot	AT	C2	25	Log	Recovery	Mortar	MEWSS	Total
Albany	3	2	14	4	1	1	1	26
Barstow	6	3	29	6	3	2	1	50
Total	**9**	**5**	**43**	**10**	**4**	**3**	**2**	**76**

Table 3.2. Estimated Annual LAV Demand by Variant.

B. TRANSPORTATION COSTS

Consolidation of depot maintenance for the LAV to a single site will increase transportation costs and lead times as vehicles require cross-country transportation for repair. We present transportation costs using the total annual demand generated in our

Annual Demand model to estimate costs of the current workload scenario and of a consolidated site at either Albany or Barstow. We consider round trip costs in our model. Transportation lead times are considered in our Readiness and DLH Cost model. Table 3.3 provides transportation costs and lead time data obtained from the Logistics Support Section, LCMC, MCLB.

From	To	Round Trip Cost	Transit Time (days)
Camp Lejeune, NC	Albany	$1,330.00	2
Quantico, VA	Albany	$1,506.00	2
Aberdeen, MD	Albany	$1,668.00	2
Ft Detrick, MD	Albany	$1,498.00	2
Kanoehe, HI	Albany	$14,006.00	55
Okinawa, Japan	Albany	$18,884.00	55
Ft Tooele, UT	Albany	$3,054.00	5
Camp Pendleton, CA	Albany	$3,832.00	7
29 Palms, CA	Albany	$3,934.00	7
Barstow	Albany	$3,884.00	7
Albany	Barstow	$4,384.00	7
Camp Lejeune, NC	Barstow	$4,766.00	7
Quantico, VA	Barstow	$3,520.00	8
Aberdeen, MD	Barstow	$3,824.00	8
Ft Detrick, MD	Barstow	$3,738.00	8
Kanoehe, HI	Barstow	$12,120.00	50
Okinawa, Japan	Barstow	$17,000.00	50
Ft Tooele, UT	Barstow	$1,152.00	5
Camp Pendleton, CA	Barstow	$870.00	2
29 Palms, CA	Barstow	$682.00	2

Table 3.3. Transportation Costs and Lead Time Data.

Conversation with the LAV Weapon System Equipment Manager (WSEM) indicates that LAV's are routinely sent from one depot to the other to balance workload at the maintenance centers. Decisions to effect transfers are made on a case-by-case basis throughout the year [Ref. 8]. In order to show the estimated annual transportation costs of lateral transfers under the current workload scenario using our Annual Demand model, we estimate the annual number of vehicles that transfer cross-country. We calculate our

estimate as a percentage of vehicles transferred cross-country in relation to total vehicles that were processed at each depot for FY's 1998 and 1999. For example, our data shows that during FY's 1998 and 1999, a total of 28 vehicles were transferred from Barstow to Albany. We divide the 28 vehicles transferred by the total number of vehicles that were processed through Barstow during the two FY's to arrive at a percentage. We multiply the percentage by our estimated total annual demand for Barstow to arrive at an estimated number of LAV's that transfer cross-country from Barstow to Albany under the current split workload scenario. Additionally, our data shows that only one vehicle transferred from Albany to Barstow during FY's 1998 and 1999, therefore, we do not consider any cross-country transfers from Albany to Barstow in our model. Table 3.4 provides transportation cost estimates for the current workload and single site scenarios.

From	Qty	Current Workload Trans Costs	Single Site, Albany	Single Site, Barstow
2d LAR Bn, Camp Lejeune, NC	15	$19,950.00	$19,950.00	$71,490.00
2d RAD Bn, Camp Lejeune, NC	1	$1,330.00	$1,330.00	$4,766.00
Aberdeen Prov Grounds, MD	1	$1,668.00	$1,668.00	$3,824.00
^Co B, 4th LAR Bn, FT Detrick, MD	5	$7,490.00	$7,490.00	$18,690.00
^Co D, 4th LAR Bn, Quantico, VA	4	$6,024.00	$6,024.00	$14,080.00
1st LAR Bn, Camp Pendleton, CA	16	$13,920.00	$61,312.00	$13,920.00
EEAP, 29 Palms, Ca	3	$2,046.00	$11,802.00	$2,046.00
3d LAR Bn, 29 Palms, CA	14	$9,548.00	$55,076.00	$9,548.00
1st RAD Bn, Hawaii	1	$12,120.00	$14,006.00	$12,120.00
School Of Infantry, Camp Pendleton, CA	3	$2,610.00	$11,496.00	$2,610.00
Co A, 4th LAR Bn, Camp Pendleton, Ca	5	$4,350.00	$19,160.00	$4,350.00
Co C, 4th LAR Bn, TOOELE, UT	3	$3,456.00	$9,162.00	$3,456.00
CAB, 3d Marine Division, Okinawa	5	$85,000.00	$94,420.00	$85,000.00
Additional Cross-Country Cost	11	$42,724.00	0	0
Total		**$212,236.00**	**$312,896.00**	**$245,900.00**

Table 3.4. Estimated Transportation Costs Under Current Workload and Single Site Scenarios.

Our results show that transportation costs increase in both single site scenarios, as expected. Our transportation cost estimates vary depending on the selection of depot for single siting. Differences are due primarily to the greater density of supported equipment at Barstow than at Albany. Additionally, cross-country transportation cost estimates provided in Table 3.3 are $934 higher, per vehicle, for LAV's originating from Camp Lejeune, than for vehicles originating from Camp Pendleton. In our model, both Camp Lejeune and Camp Pendleton provide the majority of annual demand to their respective supporting depot, accounting for 62% and 48%, respectively, of annual LAV IROAN demand.

Transportation costs for the single site scenario, Albany, are $100,660, or 47%, higher than the current workload scenario. Costs for the single site scenario, Barstow, are $33,664, or 16%, higher than the current workload scenario. Additionally, transportation costs for the current workload scenario show $42,724 in additional annual costs resulting from our estimate of 11 vehicles being laterally transferred from Barstow to Albany to balance workload. The costs of transferring LAV's from one depot to the other to balance workload may vary significantly from year to year depending on each depot's workload and scheduling requirements.

C. SECREP TRANSPORTATION COSTS

Consolidating the LAV SecRep inventory and maintenance capabilities presents additional considerations not addressed in single siting the LAV to this point. First, the DLR inventories held at the depots are centrally managed, therefore, we assume that the

operating and safety levels are calculated as a single inventory vice two separate inventories, therefore, we assume that there will be no savings from single siting the LAV SecRep inventory [Ref. 14]. However, single siting the repair part inventory to support the maintenance of SecReps will realize the same reduction in safety levels as identified in our section on Class IX repair part inventory reduction.

Second, demand for LAV DLRs from supported units are independent of scheduled depot maintenance repair cycles for the LAV as a PEI. Therefore, additional transportation costs will be realized from shipment of DLRs to supported units not associated with the LAV IROAN Program. As identified in our transportation cost estimates for the shipment of the LAV PEI to support the IROAN Program, cost increases will be caused by requirements to ship LAV DLRs cross-country to supported units.

We present transportation costs for six of a total 43 LAV DLRs in the centrally-managed MCLB inventory. Three of the selected DLRs require Less than Truckload (LTL) overland transportation because of their size and weight. We also consider transportation costs for three smaller components using standard air shipment. The six DLRs that we consider in our model account for $2,675,031, or 57%, of the total dollar value of the LAV DLRs inventory managed by MCLB. First, we estimate annual demand for each DLR using two years of historical demand data, from March 1998 to March 2000, provided by the LAV Inventory Manager, LCMC, MCLB. We consider only demand from the three Force Service Support Groups (FSSG's) located at Camp Lejeune, Camp Pendleton, and Okinawa, Japan. We then apply transportation cost

estimates as reported by Paige (2000) for LTL shipments and air transportation costs for three-day service provided by the United Parcel Service (UPS). We estimate costs under the current workload scenario and of a consolidated site at either Albany or Barstow. We then double the transportation costs under each scenario to provide an estimate of transportation costs for the remaining DLRs and demand from the other supported units. Table 3.5 provides estimated annual demand for each DLR. Table 3.6 provides transportation cost estimates for three-day air shipment. Table 3.7 provides transportation cost estimates for LTL shipments. Table 3.8 provides cost estimates for the current workload and single site scenarios.

ITEM	NSN	Estimated Weight	1st FSSG, Camp Pend, CA	2d FSSG, CLNC	3d FSSG, Okinawa
Strut Assembly	2510219083070	150	12	6	1
Transmission	2520011448667	250	3	0	0
Engine, Diesel	2815014427645	1700	5	1	0
Traverse Drive	1005011516431	90	4	2	1
Control Display Unit	1005011516429	25	5	8	2
Distribution Box	6110011642599	70	1	13	1

Table 3.5. Estimated Annual Demand for Selected DLRs.

Item	From	Albany	Barstow
Traverse Drive	Camp Lejeune	$43.44	$109.05
Traverse Drive	Camp Pendleton/Long Beach	$109.05	$43.44
Distribution Box	Camp Lejeune	$35.34	$86.47
Distribution Box	Camp Pendleton/Long Beach	$86.47	$35.34
Control Display Unit	Camp Lejeune	$22.58	$36.55
Control Display Unit	Camp Pendleton/Long Beach	$36.55	$17.01

Table 3.6. UPS Three-Day Air Service Shipping Costs.

Cost per lb.	Albany	Barstow
Camp Lejeune, NC	0.46	0.96
Camp Pendleton, CA	0.71	0.31
Long Beach, CA	0.77	0.25

Table 3.7. Shipping Cost Estimates for LTL Shipments.

			Roundtrip Cost		
Item	**From**	**Demand**	**Current Workload**	**Albany**	**Barstow**
Strut Assembly	Camp Lejeune	6	$828.00	$828.00	$1,728.00
Strut Assembly	Camp Pendleton	12	$1,116.00	$2,556.00	$1,116.00
Strut Assembly	Long Beach	1	$75.00	$231.00	$75.00
Transmission	Camp Pendleton	3	$465.00	$1,065.00	$465.00
Engine, Diesel	Camp Lejeune	1	$1,564.00	$1,564.00	$3,264.00
Engine, Diesel	Camp Pendleton	5	$5,270.00	$12,070.00	$5,270.00
Traverse Drive	Camp Lejeune	2	$173.76	$173.76	$436.20
Traverse Drive	Camp Pendleton	4	$347.52	$872.40	$347.52
Traverse Drive	Long Beach	1	$86.88	$218.10	$86.88
Control Display Unit	Camp Lejeune	8	$361.28	$361.28	$584.80
Control Display Unit	Camp Pendleton	5	$170.10	$365.50	$170.10
Control Display Unit	Long Beach	2	$68.04	$146.20	$68.04
Distribution Box	Camp Lejeune	13	$918.84	$918.84	$2,248.22
Distribution Box	Camp Pendleton	1	$70.68	$172.94	$70.68
Distribution Box	Long Beach	1	$34.02	$172.94	$70.68
Total Cost			$11,549.12	$21,715.96	$16,001.12
Total Cost Doubled			**$23,098.24**	**$43,431.92**	**$32,002.24**

Table 3.8. DLR Transportation Costs for the Current Workload and Single Site Scenarios.

Our results show that transportation costs increase in both single site scenarios. Costs for the single site scenario, Albany are $20,334, or 88%, higher than the current workload scenario. Costs for the single site scenario, Barstow, are $8,904, or 39%,

higher than the current workload scenario. Differences are due primarily to the greater demand of DLRs supported by Barstow than at Albany.

D. READINESS AND DIRECT LABOR HOUR (DLH) COST MODEL

In this model, we consider the impact on readiness of total Marine Corps LAV assets, by variant, as a result of IROAN depot maintenance requirements. We consider only readiness data for those LAV assets held by owning units supported by the depots, as identified in Table 2.1, and not LAV assets held as excess or in the War Reserve Material Readiness (WRMR) allowance at the depots. We also develop estimated direct labor costs, by depot, using results from our Annual Demand model and FY 2001 DLH cost estimates provided by the LAV Project Officer, Maintenance Directorate, MCLB [Ref. 3].

We use RCT data from Jenkins (1999). The RCT data reflects the total time a vehicle spends in the IROAN maintenance cycle, including transportation time, administrative delay times, waiting time in the queue, and Mean Time To Repair (MTTR). We use the average RCT data for the entire population of LAV's for each variant because data was not available for all variants from the depots.

A general description of our model is as follows. There is a demand of N_i LAV's, per variant i, supported by each depot, based on our Annual Demand model results. We assume vehicles arrive at a constant rate λ. Since the average time between arrivals is exponentially distributed, we model the arrival rates as $1/\lambda$, and these rates are independent of the distribution of arrivals. We calculate the Work In Process (WIP)

inventory, per variant, by multiplying the arrival rate by the RCT. We compare the WIP for each variant to the number of DMFA assets. If the WIP is less than the number of DMFA assets, then we assume no LAV's are deadlined for IROAN depot maintenance repair. If the WIP is greater than the number of DMFA assets, then we assume the difference (total number of LAV's in WIP - DMFA assets) are deadlined [Ref. 15]. We calculate readiness, for each variant, by subtracting the number of deadlined LAVs from the total number of LAVs belonging to the supported units listed in Table 2.1. We divide the difference by the total number of LAVs, per variant, to arrive at a readiness percentage.

We then calculate total DLH costs, per variant, by multiplying the estimated unit DLH by the estimated DLH costs, by the annual demand. We then total all variants to arrive at a total direct labor cost.

We assume the following:

- Constant arrival times.
- Units ship LAV's for IROAN, regardless of prior receipt of replacement vehicle.
- Depots will increase capacity to handle additional LAV workload to maintain at least the minimum RCT data used in our model.
- Time between arrivals and repair times at each depot are independent of each other.

- Organizational and intermediate maintenance repair cycles are not considered.
- IROAN repairs are conducted at the depots as scheduled (no cross-country lateral transfers were made to balance workload).

First, we calculate readiness and cost data for each maintenance center based on the current workload scenario. We then combine the data from the two depots to show the impact on total Marine Corps LAV assets by variant and the total direct labor costs of the current workload scenario. Table 3.9 provides results for MCLB Albany under the current workload scenario. Table 3.10 provides results for MCLB Barstow under the current workload scenario. Table 3.11 provides the total number of LAV assets, per variant, then combines the annual demand, WIP, DMFA, and labor costs listed in Tables 3.9 and 3.10 to show the results for the two depots under the current workload scenario.

	Anti-Tank	C2	25	Log	Mortar	Recovery	MEWSS
Demand	3	2	14	4	1	1	1
Arrival Rates (vehicles/day)	0.00822	0.00548	0.03836	0.01096	0.00274	0.00274	0.00274
Work In Process (WIP)	1.7	1.1	7.6	2.2	0.6	0.6	0.6
Unit DLH	2677	2624	2743	2209	2519	2550	2462
DLH Cost per Variant	$680,708	$444,820	$3,254,954	$748,939	$213,510	$216,138	$208,679
Total DLH Costs	$5,767,748						

Table 3.9. Albany WIP and DLH Cost Data Under Current Workload Scenario (The Average RCT and DLH Rate is 196 days and $84.76, respectively).

	Anti-Tank	C2	25	Log	Mortar	Recovery	MEWSS
Demand	6	3	29	6	3	2	1
Arrival Rates (vehicles/day)	0.01644	0.00822	0.07945	0.01644	0.00822	0.00548	0.00274
Work In Process (WIP)	3.8	1.9	18.2	3.8	1.9	1.3	0.7
Unit DLH	2654	2559	2692	2214	2602	2550	1958
DLH Cost per Variant	$1,115,635	$537,851	$5,469,444	$930,677	$546,888	$357,306	$137,177
Total DLH Costs	$9,094,979						

Table 3.10. Barstow WIP and DLH Cost Data Under Current Workload Scenario (The Average RCT and DLH Rate is 229 days and $70.06, Respectively).

	Anti-Tank	C2	25	Log	Mortar	Recovery	MEWSS
Number of LAV Assets	85	45	366	89	47	34	12
Estimated Annual Demand	9	5	43	10	4	3	2
Work In Process (WIP)	5.5	3.0	25.8	6.0	2.5	1.9	1.3
DMFA Assets	10	5	40	9	4	4	0
Deadlined Assets	0	0	0	0	0	0	1
TAMCN Readiness	100%	100%	100%	100%	100%	100%	92%
DLH Cost per Variant	$1,796,343	$982,671	$8,724,398	$1,679,616	$760,399	$573,444	$345,857
Total DLH Cost	$14,862,728						

Table 3.11. Combined Readiness and Cost Data Under Current Workload Scenario

We perform the same calculations considering single site scenarios at both Albany and Barstow. To show the impact of increased transportation lead times due to single siting, we apply an additional seven days to all variant RCTs to consider worst case scenario (see Table 3.3). We only consider increases in inland transportation lead times within the continental United States (CONUS) for our model. Actual transportation lead times vary depending on the location of the single site. Table 3.12 provides readiness and direct labor cost estimates for single site scenario, Albany. Table 3.13 provides readiness and direct labor cost estimates for single site scenario, Barstow.

	Anti-Tank	C2	25	Log	Mortar	Recovery	MEWSS
Number of LAV Assets	85	45	366	89	47	34	12
Annual Demand	9	5	43	10	4	3	2
Interarrival Rates (vehicles/day)	0.024658	0.013699	0.117808	0.027397	0.010959	0.008219	0.005479
Work In Process (WIP)	5.1	2.8	24.0	5.6	2.3	1.7	1.2
DMFA Assets	10	5	40	9	4	4	0
Deadlined Assets	0	0	0	0	0	0	1
TAMCN Readiness	100%	100%	100%	100%	100%	100%	92%
Unit DLH	2677	2624	2743	2209	2519	2550	2462
DLH Cost per Variant	$2,042,123	$1,112,051	$9,997,357	$1,872,348	$854,042	$648,414	$417,358
Total DLH Cost	**$16,943,694**						

Table 3.12. Readiness and DLH Cost Data for Single Site Scenario, Albany (The Average RCT, Including Additional Transit Time, and DLH Rate is 203 days and $84.76, Respectively).

	Anti-Tank	C2	25	Log	Mortar	Recovery	MEWSS
Number of LAV Assets	85	45	366	89	47	34	12
Annual Demand	9	5	43	10	4	3	2
Interarrival Rates (vehicles/day)	0.02466	0.01370	0.11781	0.02740	0.01096	0.00822	0.00548
Work In Process (WIP)	5.9	3.3	27.9	6.5	2.6	2.0	1.3
DMFA Assets	10	5	40	9	4	4	0
Deadlined Assets	0	0	0	0	0	0	1
TAMCN Readiness	100%	100%	100%	100%	100%	100%	92%
Unit DLH per Variant	2654	2559	2692	2214	2602	2550	1958
DLH Cost per Variant	$1,673,453	$896,418	$8,109,865	$1,551,128	$729,184	$535,959	$274,355
Total DLH Cost	**$13,770,363**						

Table 3.13. Readiness and DLH Cost Data for Single Site Scenario, Barstow (The Average RCT, Including Additional Transit Time, and DLH Rate is 236 days and $70.06, Respectively).

Our data shows that in each scenario Marine Corps LAV readiness is not affected by the IROAN depot maintenance program, with the exception of the MEWSS vehicle. Based on annual demand estimates and the RCT data provided, there are sufficient

numbers of DMFA assets to prevent units from going T/E deficient while providing vehicles to the IROAN Program. However, increased annual demand will increase the WIP in all scenarios, assuming RCT remains at the level identified in our current workload scenario. Increased throughput can be accomplished without increasing WIP by decreasing total RCT, regardless of the scenario used.

Our cost data results vary depending on the selection of depot for single siting. Differences are due primarily to varying direct labor cost estimates between the two depots. In the single site scenario using current RCT and DLH data, MCLB Albany shows an increase in costs of $2.1 million, or 14%, while MCLB Barstow shows a reduction in costs of $1.1 million, or 7.4%, from the current workload scenario.

Our model ignores variance that exists in real-world depot maintenance activities. We provide results under optimal conditions that exist if all vehicles arrive on the RDD, and that the actual RCTs are equal to the RCTs used in our model. We use a constant value for RCT and interarrival times. In reality, significant variance in RCT and interarrival times exist for each depot, which adversely affects the results. Using calculations that consider variance allows more accurate estimates of RCT and WIP. For example, the greater amount of variance that exists for arrival and cycle-time data, the higher the total RCT will be, which results in increased WIP. However, consistent RCT data did not exist for all variants, for both depots, to enable such calculations.

Additionally, funding constraints, scheduling prioritization, and policy regarding the distribution and allocation of DMFA assets will affect the actual number of RFI assets

available to using units. A decrease in the number of available DMFA assets, especially for lower density variants, will adversely affect the readiness associated with depot maintenance repair cycles.

E. CLASS IX REPAIR PART INVENTORY REDUCTION

Numerous studies have been conducted to research the potential savings resulting from consolidation of inventories. As inventory is reduced, organizations realize lower holding costs over the long run. Holding costs are considered as the cost of management and infrastructure required to maintain inventories, as well as the oppotunity cost of capital that could have been spent on other organizational requirements. Kang (2000) states that consolidating inventories leads to less variability in demand and reduces the level of required safety stocks.

Gue (2000) presents a similar example by using the Square Root Law of Pooling. He shows, mathematically, that the sum of independent variances realized by decentralized inventories is greater than the pooled variance of a centralized inventory. This reduction in variance leads to decreased requirements for operating and safety level inventories.

Wirwille and Ainsworth (1991) suggest similar results in their analysis of consolidating aircraft intermediate maintenance capabilities. They state that, "consolidating inventory can reduce the quantity of parts required for safety stock. because as demand is concentrated to fewer stocking points, there is less uncertainty in demand to take into consideration and total safety stocks can be reduced."

Our intent was to develop a model using a sample of LAV specific repair parts to show potential savings from consolidating inventories. However, we were unable to obtain an accurate listing of LAV specific repair parts with RO, ROP, DUR, and safety stock levels. Therefore, we are unable to make a valid estimate of the population of LAV repair part inventories and the potential savings resulting from single siting.

F. PERSONNEL REDUCTION SAVINGS

Over the past decade, many DoD organizations have initiated consolidation efforts that have led to significant savings from personnel reductions. A 1997 General Accounting Office (GAO) report cited the Navy's success in closing six aviation maintenance depots during the 1990 to 1997 time period. By consolidating workloads of the closed depots, increased outsourcing efforts, and personnel force reductions and redistributions, the Navy realized a reduced hourly operating rate of approximately $10 an hour, which led to estimated long term annual savings of $130 million [Ref. 16].

Conversation with personnel at both maintenance centers and the Maintenance Directorate, MCLB indicate there is potential for manpower savings from single siting the LAV through greater efficiency in the use of labor [Ref. 4, 5, 6]. Therefore, it is reasonable to assume that by consolidating activities from two sites to one, that total personnel requirements of the single site can be reduced.

As previously stated, however, accurate assessments of personnel reductions due to single siting the LAV requires a detailed analysis of the production line design, including consideration of annual LAV IROAN demand, the effect on workload for the

backshops, and any potential impact on the production of other weapon systems. Additionally, because of the multi-commodity capability of the depots and the fluctuations in annual demand for the LAV and other weapon systems, personnel shifts routinely occur that change the personnel structure assigned to the LAV.

We provide an example of potential savings from personnel reductions by using data from the former Program Management Section Head, Maintenance Directorate, MCLB that identifies personnel that spent 50% or more of their time assigned to the LAV production line, specifically. The data provided the portion of annual salary commensurate to the percentage of time spent on the LAV throughout the year. For example, if there are three Heavy Mobile Equipment Mechanics (HMEM), Wage Grade (WG)-05, with an annual salary of $28,100, that spent 50% of their time on the LAV, then the total of their combined salaries attributable to the LAV is: (3 * $28,100 * .50) to arrive at an annual salary cost for the three HMEM of $42,150 [Ref. 17]. A number of pay grade and salary data were missing from the Barstow personnel list. Therefore, we estimated each of the missing pay grades and salaries as a WG-05, with an annual salary of $28,100, which is the lowest salary reported from either depot considering 100% of time allocated to the LAV.

The total salary cost for both depots under the current workload scenario is $2,944,959. A 10% reduction in personnel resulting from single siting amounts to an annual savings of $294,496. Our estimated reduction in personnel requirements merely serves a conservative example of potential savings that could occur from single siting the

LAV. In reality, however, many sensitive labor-relation and political issues exist that prohibit the immediate determination of the impact on workforce strucure, therefore, we do not include savings from potential reduction savings in our Net Savings (Cost) model.

It is important to note that our data only accounts for personnel assigned to the maintenance center at each depot that spent 50% or more of their time on the LAV production line, specifically. Therefore, actual labor costs will be higher when considering the amount of personnel that spend less than 50% of their time on the LAV, both in the backshops and on the main production line.

G. RESULTS

We present our estimated total savings (costs) associated with single siting the LAV by combining the difference in costs for each category for the current workload scenario and the single site scenarios to arrive at an annual net savings (cost). Table 3.14 provides estimated net annual savings (costs) for each depot.

	Albany	Barstow
Facility Upgrade (Costs)	0	0
PEI Transportation (Costs)	($100,660)	($33,664)
SecRep Transportation (Costs)	($20,334)	($8,904)
DLH Savings (Costs)	($2,080,966)	$1,092,364
SecRep Inventory Savings	0	0
Class IX Repair Part Inventory Savings	N/A	N/A
Total Savings (Costs)	**($2,201,960)**	**$1,049,796**

Table 3.14. Net Savings (Costs) Associated With Single Siting.

Our results show that Albany increases costs by $2.2 million per year from the curent workload scenario, while Barstow realizes annual savings of $1.1 million from the current workload scenario. Transportation costs for both PEIs and SecReps are

significantly higher in the single site scenario for Albany than Barstow. As previously stated, this is due primarily to the greater density of supported equipment on the west coast. The largest cost driver for Albany, however, is the cost of DLH. Albany's estimated DLH rate is $14.70 per hour higher than Barstow's, which has a significant affect on direct labor costs when considering the estimated minimum number of hours to complete one LAV is over 2,200 hours.

We do not consider potential savings from consolidating Class IX repair parts because of our inability to provide a valid estimate of either depot's inventory levels, requirements determination, or replenishment process. We do believe, however, that by consolidating inventories that each single site scenario would be able to realize some savings, but that these savings will not be significant enough to eliminate the net increase in costs from the single site scenario, Albany. We base this on the fact that the inventory reduction from a consolidated inventory would have to be greater than $10.4 million ($10.4 million multiplied by 21% holding cost savings) to equal the $2.2 million in increased costs. Paige (2000) reports the Navy considers inventory holding costs are 21% annually.

Additionally, although we do not include potential savings from personnel reductions as provided in our example, we do believe that single siting the LAV could lead to a reduction in total personnel requirements, which reduces annual salary costs.

H. ADDITIONAL ISSUES

Several additional issues exist that must be addressed when considering the concept of single siting. These issues are socially and politically sensitive, and are harder to quantify than the data we have presented to this point. Many of the issues center around two primary areas, the social and political impact on single siting a major weapon system, and the potential impact on surge capacity and readiness.

1. Social and Political Impact

As we eluded to in our discussion of depot capacity, single siting a major weapon system will increase the workload and utilization of one depot while simultaneously decreasing the workload and utilization at the other. Excess capacity is created at the depot losing the workload, with the biggest impact being on direct and indirect labor. Sensitive decisions are required to either shift equivalent workload(s) to compensate for the excess capacity, a reduction in workforce structure, or shift personnel to other jobs within the depot. In any case, single siting a major weapon system such as the LAV will affect the scheduling and maintenance capabilities, at least in the short term, at both depots.

Additionally, consideration must be given to the impact on the Navy Working Capital Fund (NWCF) resulting from changes to depot workloads. DoD activities operating under the NWCF do not receive annual appropriations for operations, but finance their activities through the receipt of customer orders. This means that NWCF activities provide goods and services on a reimbursable basis. Part of the customer's cost

of services performed is the cost of overhead, which results from capital investments in infrastructure and management personnel not directly associated with a single product line. These overhead costs are spread among the various product lines and services provided to customers. Therefore, reductions in workload of a major weapon system, without a transfer of equivalent workload to the losing depot, will increase the overhead costs of the remaining product lines [Ref. 18].

2. Surge Capacity

An important consideration in single siting the LAV is the impact on the depots' ability to meet short-notice, emergent requirements either during peacetime operations or in support of contingency situations. It is reasonable to assume that if both depots are running a production line for the LAV, that the ability to surge is greater than that of a single production line, at least in the short term. Additionally, any disruption in, or loss of, the maintenance capability at a single site would have a significant, adverse affect on the depot maintenance support and readiness of the LAV. This issue requires careful consideration of the savings of single siting compared to the risks associated with surge requirements and the potential loss of maintenance capability of a single site.

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IV. CONCLUSIONS AND RECOMMENDATIONS

We sought to determine if single siting the LAV leads to the most efficient allocation of depot resources, while considering the trade-offs involved with consolidation of depot maintenance for a major weapon system. We developed models to estimate the savings (costs) of certain quantifiable data associated with single siting the LAV. We provided our results for each of the following categories: PEI and SecRep transportation costs, readiness data, and unit DLH costs. We then combined the results for each category to arrive at a net annual savings (costs) for each depot.

A. CONCLUSIONS

Our data shows that the Marine Corps would realize annual savings by single siting the LAV at Barstow, while single siting at Albany would actually increase annual costs from the current workload scenario. Barstow shows an annual savings of $1.1 million, while Albany shows and annual increase in costs of $2.2 million. This difference is due to lower DLH rates reported by Barstow and the greater density of LAV assets in the geographical region supported by Barstow which results in a lower transportation cost increase from the current workload scenario than if the LAV were single sited at Albany.

Our results show that the most significant savings (cost) of single siting depot maintenance for the LAV is labor. In our Readiness and DLH Cost model, we show a significant difference in DLH costs between the two depots. Albany reports a DLH rate that is $14.70 more, per hour, than Barstow. This results in an increase in DLH costs of

the single site scenario for Albany of $2.1 million from the current workload scenario, while the DLH estimate of the single site scenario for Barstow shows a savings of $1.1 million from the current workload scenario.

The results of our readiness model show that in an optimal environment where LAV assets arrive as scheduled, and the RCT for each vehicle is equal to the reported RCT for each depot, that there are sufficient numbers of DMFA assets to maintain high levels of readiness, regardless of the scenario considered. However, the variance encountered in real-world depot maintenance operations from scheduling, vehicle arrivals, and RCT increases the number of vehicles in WIP. Additionally, funding constraints, scheduling prioritization, and policy regarding DMFA asset allocation will affect the amount of RFI DMFA assets.

Both depots possess a multi-commodity capability that allows them to handle the increased workload of a single sited LAV depot maintenance program without increased infrastructure or external personnel (capacity) requirements. However, single siting the LAV will create excess capacity at the depot losing the workload, specifically with respect to direct and indirect labor requirements. The excess capacity will require transferring equivalent workload from one depot to the other, potential reductions in the workforce structure, redistributing personnel to other jobs within the depot, or a combination of these options. Due to these various options, and our inability to provide accurate estimates on the impact of personnel structure from single siting, we do not include potential savings in our Net Savings (Costs) model.

Single siting a major weapon system potentially increases the risk of reduced surge capacity in the event of emergent requirements or loss of maintenance capability at the consolidated site.

B. RECOMMENDATIONS

1. The Marine Corps should single site depot maintenance for the LAV.

Our research shows that single siting the LAV at Barstow will lead to annual savings of over $1.1 million. If single siting the LAV to one depot is decided considering cost reductions alone, and is accomplished without any trade-off of equivalent workload to the other depot, then the clear choice would be to consolidate at Barstow. However, if workload is shifted from one depot to another to prevent excess capacity from occuring, then similiar cost-benefit analysis will be required to determine the most efficient allocation of single-sited workload(s) at each depot.

2. Conduct further cost-benefit analysis to consider single siting other weapon systems.

If single siting a major weapon system can lead to greater efficiency and allocation of resources, then the bigger issue is not whether the LAV should be single sited, but whether consideration should be given to single siting other weapon systems to one depot or another. This will reduce the number of commodities each depot works on, yet allows retention of a multi-commodity capability at each depot.

3. Develop better IT capabilities that will integrate data requirements and processes between maintenance and supply activities, and the supporting corporate headquarters.

Our research highlights several problems encountered in data collection and reporting capabilities for the two depots. A lack of integrated, information technology (IT) capabilities result in data collection voids and suspect accuracy of the data reported. Additionally, there is currently no automated means by which to capture, extract, nor integrate RCT data within either depot. RCT data that is captured by the maintenance centers generally includes only Mean Time To Repair (MTTR) data from the maintenance center. Transportation lead times and time spent in the queue at the FSC awaiting induction into the maintenance cycle are captured separately, by manual processes. As addressed by Jenkins (1999), and confirmed during conversation with key personnel, most data is captured manually and imported into local databases, and when accurate data cannot be retrieved, default data is used as a substitute [Ref. 19, 20, 21].

4. Develop better methods for forecasting repair part requirements, replenishment, and inventory level reporting.

Our research showed that the accuracy of the ROs listed in the NIMMS database were suspect. Therefore, the method used to generate the RO is to multiply the DUR by 45, which includes a 30-day Operating Level and 15-day Safety Level.

Additionally, ROPs do not exist in the NIMMS system. Replenishment is accomplished by a review document being processed for a repair part as an item is

consumed. LAV Production Planners review the document and check on hand inventories and forecasted production schedules to determine if replenishment action should be initiated [Ref. 22, 23, 24].

Lastly, a large portion of sample NSNs did not have DURs that could be used to generate ROs. Upon receipt of data from the depots, 54 of 98 requested NSNs, or 55%, had either missing or suspect DURs, which did not allow for accurate calculation of inventories. An absence of accurate forecasting tools for inventory requirements determination and no method to check actual usage data against forecasted amounts leads to a manual replenishment process and innaccurate reporting of data.

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APPENDIX A. FISCAL YEARS (FY'S) 1998 AND 1999 ACTUAL THROUGHPUT AND 2000 – 2003 ESTIMATED DEMAND DATA FOR MCLB ALBANY

From	To	Qty
2d LAR Bn, Camp Lejeune, NC	Albany	12
2d RAD Bn, Camp Lejeune, NC	Albany	0
Aberdeen Prov Grounds, MD	Albany	2
Co B, 4th LAR Bn, FT Detrick, MD	Albany	7
Co D, 4th LAR Bn, Quantico, VA	Albany	6
Total	Albany	**27**

Table A.1. FY 98 Actual Throughput.

From	To	Qty
2d LAR Bn, Camp Lejeune, NC	Albany	22
2d RAD Bn, Camp Lejeune, NC	Albany	0
Aberdeen Prov Grounds, MD	Albany	1
Co B, 4th LAR Bn, FT Detrick, MD	Albany	7
Co D, 4th LAR Bn, Quantico, VA	Albany	7
Total	Albany	**37**

Table A.2. FY 99 Actual Throughput.

From	To	Qty
2d LAR Bn, Camp Lejeune, NC	Albany	17
2d RAD Bn, Camp Lejeune, NC	Albany	1
Aberdeen Prov Grounds, MD	Albany	0
Co B, 4th LAR Bn, FT Detrick, MD	Albany	5
Co D, 4th LAR Bn, Quantico, VA	Albany	4
Total	Albany	**27**

Table A.3. FY 00 Estimated Demand.

From	To	Qty
2d LAR Bn, Camp Lejeune, NC	Albany	13
2d RAD Bn, Camp Lejeune, NC	Albany	2
Aberdeen Prov Grounds, MD	Albany	0
Co B, 4th LAR Bn, FT Detrick, MD	Albany	3
Co D, 4th LAR Bn, Quantico, VA	Albany	3
Total	Albany	**21**

Table A.4. FY 01 Estimated Demand.

From	To	Qty
2d LAR Bn, Camp Lejeune, NC	Albany	6
2d RAD Bn, Camp Lejeune, NC	Albany	1
Aberdeen Prov Grounds, MD	Albany	0
Co B, 4th LAR Bn, FT Detrick, MD	Albany	1
Co D, 4th LAR Bn, Quantico, VA	Albany	1
Total	Albany	**9**

Table A.5. FY 02 Estimated Demand.

From	To	Qty
2d LAR Bn, Camp Lejeune, NC	Albany	23
2d RAD Bn, Camp Lejeune, NC	Albany	2
Aberdeen Prov Grounds, MD	Albany	0
Co B, 4th LAR Bn, FT Detrick, MD	Albany	5
Co D, 4th LAR Bn, Quantico, VA	Albany	5
Total	Albany	**35**

Table A.6. FY 03 Estimated Demand.

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APPENDIX B. FISCAL YEARS (FY'S) 1998 AND 1999 ACTUAL THROUGHPUT AND 2000-2003 ESTIMATED DEMAND DATA FOR MCLB BARSTOW

From	To	Qty
1st LAR Bn, Camp Pendleton, CA	Barstow	25
EEAP, 29 Palms, CA	Barstow	0
3d LAR Bn, 29 Palms, CA	Barstow	20
1st RAD Bn, Hawaii	Barstow	0
School Of Infantry, Camp Pendleton, CA	Barstow	8
Co A, 4th LAR Bn, Camp Pendleton, CA	Barstow	10
Co C, 4th LAR Bn, TOOELE, UT	Barstow	2
CAB, 3d Marine Division, Okinawa	Barstow	3
Total	**Barstow**	**68**

Table B.1. FY 98 Actual Throughput.

FROM	TO	Qty
1st LAR Bn, Camp Pendleton, CA	Barstow	18
EEAP, 29 Palms, CA	Barstow	2
3d LAR Bn, 29 Palms, CA	Barstow	13
1st RAD Bn, Hawaii	Barstow	0
School Of Infantry, Camp Pendleton, CA	Barstow	7
Co A, 4th LAR Bn, Camp Pendleton, CA	Barstow	3
Co C, 4th LAR Bn, TOOELE, UT	Barstow	3
CAB, 3d Marine Division, Okinawa	Barstow	7
Total	**Barstow**	**53**

Table B.2. FY 99 Actual Throughput.

From	To	Qty
1st LAR Bn, Camp Pendleton, CA	Barstow	16
EEAP, 29 Palms, CA	Barstow	5
3d LAR Bn, 29 Palms, CA	Barstow	14
1st RAD Bn, Hawaii	Barstow	2
School Of Infantry, Camp Pendleton, CA	Barstow	3
Co A, 4th LAR Bn, Camp Pendleton, CA	Barstow	5
Co C, 4th LAR Bn, TOOELE, UT	Barstow	5
CAB, 3d Marine Division, Okinawa	Barstow	4
Total	Barstow	**54**

Table B.3. FY 00 Estimated Demand.

From	To	Qty
1st LAR Bn, Camp Pendleton, CA	Barstow	9
EEAP, 29 Palms, CA	Barstow	4
3d LAR Bn, 29 Palms, CA	Barstow	11
1st RAD Bn, Hawaii	Barstow	1
School Of Infantry, Camp Pendleton, CA	Barstow	0
Co A, 4th LAR Bn, Camp Pendleton, CA	Barstow	3
Co C, 4th LAR Bn, TOOELE, UT	Barstow	3
CAB, 3d Marine Division, Okinawa	Barstow	4
Total	Barstow	**35**

Table B.4. FY 01 Estimated Demand.

From	To	Qty
1st LAR Bn, Camp Pendleton, CA	Barstow	5
EEAP, 29 Palms, CA	Barstow	3
3d LAR Bn, 29 Palms, CA	Barstow	5
1st RAD Bn, Hawaii	Barstow	2
School Of Infantry, Camp Pendleton, CA	Barstow	0
Co A, 4th LAR Bn, Camp Pendleton, CA	Barstow	2
Co C, 4th LAR Bn, TOOELE, UT	Barstow	1
CAB, 3d Marine Division, Okinawa	Barstow	3
Total	Barstow	**21**

Table B.5. FY 02 Estimated Demand.

From	To	Qty
1st LAR Bn, Camp Pendleton, CA	Barstow	20
EEAP, 29 Palms, CA	Barstow	5
3d LAR Bn, 29 Palms, CA	Barstow	18
1st RAD Bn, Hawaii	Barstow	1
School Of Infantry, Camp Pendleton, CA	Barstow	1
Co A, 4th LAR Bn, Camp Pendleton, CA	Barstow	7
Co C, 4th LAR Bn, TOOELE, UT	Barstow	5
CAB, 3d Marine Division, Okinawa	Barstow	10
Total	Barstow	**67**

Table B.6. FY 03 Estimated Demand.

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APPENDIX C. FISCAL YEARS (FY'S) 1998 AND 1999 ACTUAL THROUGHPUT AND 2000-2003 ESTIMATED DEMAND FOR LAV VARIANTS

Depot	AT	C2	25	Log	Recovery	Mortar	MEWSS	Total
Albany	4	3	15	3	2	0	0	27
Barstow	4	5	42	12	3	2	0	68
Total	8	8	57	15	5	2	0	**95**

Table C.1. FY 98 Actual Throughput.

Depot	AT	C2	25	Log	Recovery	Mortar	MEWSS	Total
Albany	2	5	21	6	0	2	0	36
Barstow	4	3	36	5	5	1	0	54
Total	6	8	57	11	5	3	0	**90**

Table C.2. FY 99 Actual Throughput.

Depot	AT	C2	25	Log	Recovery	Mortar	MEWSS	Total
Albany	4	1	15	3	1	2	1	27
Barstow	9	1	32	6	0	4	2	54
Total	13	2	47	9	1	6	3	**81**

Table C.3. FY 00 Estimated Demand.

Depot	AT	C2	25	Log	Recovery	Mortar	MEWSS	Total
Albany	3	3	6	3	2	2	2	21
Barstow	8	3	10	6	3	4	1	35
Total	11	6	16	9	5	6	3	**56**

Table C.4. FY 01 Estimated Demand.

Depot	AT	C2	25	Log	Recovery	Mortar	MEWSS	Total
Albany	0	0	8	0	0	0	1	9
Barstow	0	0	19	0	0	0	2	21
Total	0	0	27	0	0	0	3	**30**

Table C.5. FY 02 Estimated Demand.

Depot	AT	C2	25	Log	Recovery	Mortar	MEWSS	Total
Albany	5	1	18	5	3	2	2	36
Barstow	8	3	38	6	7	3	1	66
Total	13	4	56	11	10	5	3	**102**

Table C.6. FY 03 Estimated Demand.

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LIST OF REFERENCES

1. Jenkins, Captain, T. M., USMC, Business Division, Marine Corps Logistics Bases, Albany, GA, Private Communication, October, 31, 2000

2. Mayberry, C.Y., Light Armored Vehicle Branch (Code 832), Life Cycle Managment Center, Marine Corps Logistics Bases, Albany, GA, Private Communication, October 5, 2000

3. Madeline, Captain, C.G., USMC, Light Armored Vehicle Project Officer, Maintenance Directorate (L20), Marine Corps Logistics Bases, Albany, GA, Private Communication, September 29, 2000

4. Interview with Colonel Cerney, R. W., USMC, Director, Maintenance Center, Marine Corps Logistics Base, Albany, GA, July 18 and October 4, 2000

5. Telephone Interview with Mr. Gary Baker, Deputy Commander, Maintenance Directorate, Marine Corps Logistics Base, Barstow, CA, October 13, 2000

6. Brown, Lieutenant Colonel, K. M., USMC, Deputy Director, Maintenance Directorate, Marine Corps Logistics Bases, Albany, GA, Private Communication, October 30, 2000

7. Joint Depot Maintenance Activities Group [1998]. "Defense Depot Maintenance Council's Business Plan for Fiscal Years 1998 - 2003." Retrieved August 23, 2000 on the World Wide Web: http://www.jdmag.wpafb.af.mil/dbp3-3.htm

8. Lackey, M., Light Armored Vehicle Weapon System Equipment Manager, Life Cycle Management Center, Marine Corps Logistics Bases, Albany, GA, Private Communication, October 6 and 30, 2000

9. Marine Corps Order (MCO) 4490, "Ground Equipment Approved Acquisition Objective (AAO) Process," May 1997

10 Olson, G. B., Decision Support Branch, Marine Corps Logistics Bases, Albany, GA, Private Communication, September 9, 2000

11. Marine Corps Logistics Base Order (MCLOBASEO) P4400.4, "Material Control Center Corporate Operating Procedures (MCC COP)," March 1999

12. Paige, L. G. "Inventory Management of Repairables in the U.S. Marine Corps - A Virtual Warehouse Concept," Master's Thesis, Naval Postgraduate School, Monterey, CA, June 2000

13. Marine Corps Order (MCO) P4400.72, "Regulated/Controlled Item Management Manual," February 1985

14. Mayberry, C. Y., Light Armored Vehicle Weapon System Equipment Management Section, Life Cycle Management Center, Marine Corps Logistics Bases, Albany, GA, Private Communication, October 19 and 30, 2000

15. Kang, Professor, K., "Spreadsheet Decision Support Model for Aviation Logistics," September 1993

16. General Accounting Office (GAO) Report [1997]. "Defense Depot Maintenance: Uncertainties and Challenges DoD Faces in Restructuring Its Depot Maintenance Program (GAO/T-NSIAD-97-1111)." Retrieved November 1, 2000 on the World Wide Web: http//www.fas.org/man/gao/ns97111.htm

17. Braden, Lieutenant Colonel, B. R., USMC, Operations Division, U.S. Marine Corps Material Command, Albany, GA, Private Communication, August 31, 2000

18. Naval Postgraduate School, "A Handbook of Practical Financial Management Topics for the DoD Financial Manager," January 2000

19. Mayberry, C.Y., Light Armored Weapon System Equipment Management Section, Life Cycle Management Center, Marine Corps Logistics Bases, Albany, GA, November 1, 2000

20. Caldiera, A., Material Support Branch, Material Management Division, Life Cycle Management Center, Marine Corps Logistics Bases, Albany, GA, Private Communication, November 1, 2000

21. Paige, Captain, L. G., USMC, Secondary Repairable Program, Life Cycle Management Center, Marine Corps Logistics Bases, Albany, GA, Private Communication, November 1, 2000

22. Cross, H., Material Management Division, Maintenance Center, Marine Corps Logistics Bases, Albany, GA, Private Communication, November 1, 2000

23. Streater, G., Production Management Section, Maintenance Center, Marine Corps Logistics Base, Albany, GA, Private Communication, October 19, 2000

24. Lovette, J. C., Management Information System, Maintenance Center, Marine Corps Logistics Base, Barstow, CA, October 18, 2000

25. Cook, J. S., "Analysis of Consolidation of Intermediate Level Maintenance for Atlantic Fleet T700-GE-401 Engines," Master's Thesis, Naval Postgraduate School, Monterey, CA, June 1992

26. Gue, Professor, K. R., Production Management Course, Naval Postgraduate School, Monterey, CA, September 2000

27. Jenkins, Captain, T.M., USMC, "Repair Cycle Time Study," Business Division, Marine Corps Logistics Bases, Albany, GA, September 1999

28. Kang, Professor, K., Logistics Engineering Course, Naval Postgraduate School, Monterey, CA, May 2000

29. Went, General, J. J., USMC (Ret), et. al., "Depot Maintenance Consolidation Study," Office of the Joint Chiefs of Staff, Washigton, D. C., 1993

30. Wirwille and Wright, "Analysis of A Proposal to Consolidate Aircraft Intermediate Maintenance Capability," Master's Thesis, Naval Postgraduate School, Monterey, CA, December 1991

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